

CLAIMS

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1. (Thrice Amended) A gate stack structure situated over a semiconductor material layer, said gate stack structure comprising:

- a gate oxide layer on said semiconductor material layer;
- a gate layer, comprising a first conductive material, on said gate oxide layer;
- a layer of refractory metal silicide on said gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of refractory metal silicide;
- a spacer over a lateral side of the gate layer and in contact with said semiconductor material layer, said spacer comprising a nonconductive material, wherein the lateral side of the gate layer is oriented perpendicular to said base semiconductor material layer;
- a contact plug having a base in contact with said semiconductor material layer, said contact plug comprising a second conductive material and being situated adjacent to the gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and
- a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a conductive layer is disposed along said lateral wall of said contact plug, said conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped

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silicon dioxide on the other of said sides, such that said conductive layer is a refractory metal.

2. The gate stack structure as recited in Claim 1, wherein said nonconductive material comprises silicon nitride.

3. The gate stack structure as recited in Claim 1, wherein:
said nonconductive material comprises undoped silicon dioxide; and
the spacer is made from the same material as the undoped silicon dioxide cap.

4. The gate stack structure as recited in Claim 1, wherein the semiconductor material is monocrystalline silicon.

5. The gate stack structure as recited in Claim 1, wherein said refractory metal silicide layer is tungsten silicide.

6. The gate stack structure as recited in Claim 1, wherein said layer of doped silicon dioxide layer comprises a material selected from the group consisting of BPSG, PSG, and BSG.

7. The gate stack structure as recited in Claim 1, wherein the spacer comprises a material that is one of silicon nitride and undoped silicon dioxide.

8. The gate stack structure as defined in Claim 1, wherein the first conductive material is polysilicon.

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9. (Thrice Amended) A gate stack structure situated over a monocrystalline silicon layer, said gate stack structure comprising:

a gate oxide layer on said monocrystalline silicon layer;

a polysilicon gate layer on said gate oxide layer;

a layer of tungsten silicide on said polysilicon gate layer;

an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide;

a spacer over a lateral side of the gate layer and in contact with said monocrystalline silicon layer, said spacer comprising undoped silicon dioxide and being integral with the undoped silicon dioxide cap, wherein the lateral side of the gate layer is oriented perpendicular to said base monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being adjacent to said gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide comprising a material selected from the group consisting of BPSG, PSG, and BSG, and being situated over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a conductive layer is disposed along said lateral wall of said contact plug, said conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said conductive layer is a refractory metal.

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10. (Four Times Amended) A gate stack structure situated over a monocrystalline silicon layer, said gate stack structure comprising:

a gate oxide layer on said monocrystalline silicon layer;

a polysilicon gate layer on said gate oxide layer;

a layer of tungsten silicide on said polysilicon gate layer;

an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide;

a spacer over a lateral side of the gate layer and in contact with said monocrystalline silicon layer, said spacer comprising a material that is one of silicon nitride and undoped silicon dioxide and being made from the same material as the undoped silicon dioxide cap, wherein the lateral side of the gate layer is oriented perpendicular to said monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being adjacent to said gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide comprising a material selected from the group consisting of BPSG, PSG, and BSG, and being situated over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a conductive layer is disposed along said lateral wall of said contact plug, said conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said conductive layer is a refractory metal.

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11. (Thrice Amended) A gate structure comprising:
a pair of gate stacks situated over a semiconductor material layer, each said gate stack comprising:
a gate oxide layer on said semiconductor material layer;
a gate layer, comprising a first conductive material, on said gate oxide layer;
a layer of refractory metal silicide on said gate layer;
an undoped silicon dioxide cap on and in contact with said layer of refractory metal silicide; and
a spacer in contact with a lateral side of each said gate stack and with said semiconductor material layer, said spacer comprising a nonconductive material, each said lateral side of each said gate stack being perpendicular to said base semiconductor material layer;
a contact plug having a base in contact with said semiconductor material layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and
a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a conductive layer is disposed along said lateral wall of said contact plug, said conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said conductive layer is a refractory metal.

12. A gate structure as recited in Claim 11, wherein said nonconductive material comprises silicon nitride.

13. The gate structure as recited in Claim 11, wherein:
said nonconductive material comprises undoped silicon dioxide; and
each said spacer is made from the same material as a respective one of said undoped silicon dioxide caps.

14. The gate structure as recited in Claim 11, wherein the semiconductor material is monocrystalline silicon.

15. The gate structure as recited in Claim 11, wherein said refractory metal silicide layer is tungsten silicide.

16. The gate structure as recited in Claim 11, wherein said layer of doped silicon dioxide layer comprises a material selected from the group consisting of BPSG, PSG, and BSG.

17. The gate structure as recited in Claim 11, wherein the spacer comprises a material that is one of silicon nitride and undoped silicon dioxide.

18. A gate structure as defined in Claim 11, wherein the first conductive material is polysilicon.

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19. (Four Times Amended) A gate structure comprising:
a pair of gate stacks situated over a monocrystalline silicon layer, each
said gate stack comprising:
a gate oxide layer on said monocrystalline silicon layer;
a polysilicon gate layer on said gate oxide layer;
a layer of tungsten silicide on said polysilicon gate layer;
an undoped silicon dioxide cap on and in contact with said layer of
tungsten silicide; and
a spacer over a lateral side of each said gate stack and in contact
with said monocrystalline silicon layer, said spacer comprising undoped
silicon dioxide and being made from the same material as the undoped
silicon dioxide cap, wherein the lateral side of each said gate stack is
oriented perpendicular to said monocrystalline silicon layer;
a contact plug having a base in contact with said monocrystalline silicon
layer, said contact plug comprising a second conductive material and being
situated between said pair of gate stacks, over said spacer, and over a portion
of said undoped silicon dioxide cap, said contact plug having a top and a lateral
wall extending from said top to said base, wherein said lateral wall is not vertical
along its height from said top to said base; and
a layer of doped silicon dioxide over and in contact with said spacer, over
and in contact with said undoped silicon dioxide cap, and adjacent to and in
contact with said contact plug, wherein a conductive layer is disposed along said
lateral wall of said contact plug, said conductive layer having said contact plug
on one of its two opposite sides and having said spacer and said layer of doped
silicon dioxide on the other of said sides, such that said conductive layer is a
refractory metal.

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20. (Thrice Amended) A gate structure comprising:
a pair of gate stacks situated over a monocrystalline silicon layer, each
said gate stack comprising:
a gate oxide layer on said monocrystalline silicon layer;
a polysilicon gate layer on said gate oxide layer;
a layer of tungsten silicide on said polysilicon gate layer;
an undoped silicon dioxide cap on and in contact with said layer of
tungsten silicide; and
a spacer over a lateral side of each said gate stack and in contact
with said monocrystalline silicon layer, said spacer comprising a material
that is one of silicon nitride and undoped silicon dioxide, each said lateral
side of each said gate stack being perpendicular to said monocrystalline
silicon layer;
a contact plug having a base in contact with said monocrystalline silicon
layer, said contact plug comprising a second conductive material and being
situated between said pair of gate stacks, over said spacer, and over a portion
of said undoped silicon dioxide cap, said contact plug having a top and a lateral
wall extending from said top to said base, wherein said lateral wall is not vertical
along its height from said top to said base; and
a layer of doped silicon dioxide over and in contact with said spacer, over
and in contact with said undoped silicon dioxide cap, and adjacent to and in
contact with said contact plug, wherein a conductive layer is disposed along said
lateral wall of said contact plug, said conductive layer having said contact plug
on one of its two opposite sides and having said spacer and said layer of doped
silicon dioxide on the other of said sides, such that said conductive layer is a
refractory metal.